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USPT,PGPB,JPAB,EPAB,DWPI,TDBD	l14 and symbol	9	<u>L15</u>
USPT,PGPB,JPAB,EPAB,DWPI,TDBD	l7 and ticke\$2 near3 identifie\$2	52	<u>L14</u>
USPT,PGPB	l12 and symbol	9	<u>L13</u>
USPT,PGPB	l7 and ticke\$2 near3 identifie\$2	52	<u>L12</u>
USPT,PGPB	((((705/37)!..CCLS.))	321	<u>L11</u>
USPT,PGPB	((((705/36)!..CCLS.))	244	<u>L10</u>
USPT,PGPB	((((705/35)!..CCLS.))	424	<u>L9</u>
USPT,PGPB	((((705/35-37)!..CCLS.))	0	<u>L8</u>
USPT,PGPB	((((705/\$)!..CCLS.))	7648	<u>L7</u>
USPT,PGPB	((((704/10)!..CCLS.))	178	<u>L6</u>
USPT,PGPB	((((704/\$)!..CCLS.))	7075	<u>L5</u>
USPT,PGPB	((((707/\$)!..CCLS.))	11370	<u>L4</u>
USPT,PGPB	((((707/4)!..CCLS.))	851	<u>L3</u>
USPT,PGPB	((((707/100)!..CCLS.))	865	<u>L2</u>
USPT,PGPB	((707/1)!..CCLS.)	1123	<u>L1</u>

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L13: Entry 6 of 9

File: USPT

Nov 16, 1999

DOCUMENT-IDENTIFIER: US 5987432 A

TITLE: Fault-tolerant central ticker plant system for distributing financial market data

BSPR:

The continuous reporting from the major exchanges (e.g., New York Stock Exchange, Chicago Board of Options Exchange, et al.) of financial market data such as stock trades, option premiums, securities transaction volume and the like, is denominated in the art as the "ticker data feed", which normally includes transaction price and volume data associated with a trade keyed to a "ticker symbol" representing the security traded. Ticker feed data are created when a trade is actually made on the floor of the exchange. As such, the ticker data feed includes only the raw trading information reported by floor brokers and does not usually include derivative financial data such as accumulated volume, price extremes over selected time intervals, statistical trends, and consolidated data for securities traded on several independent exchanges. Moreover, the ticker data feed is unresponsive to requests for current financial market data for specific securities, which are available only from some database in which the ticker feed data are stored and updated.

DEPR:

Some input feeds provide consolidated ticker stream data from many different exchanges. For instance, the Securities Industry Automation Corporation (SIAC) provides two ticker streams identified as the Consolidated Tape System (CTS) and the Consolidated Quote System (CQS). The CTS feed conforms to the latest revision of the Consolidated Tape System (CTS) Vendor Communications Interface Specifications of Jun. 10, 1986. The CQS stream conforms to the latest revision of Consolidated Quotation Service (CQS) Vendor Communications Interface Specifications of Apr. 15, 1987. Both the CTS and CQS input feeds provide ticker stream data from the New York Stock Exchange, American Stock Exchange, Midwest Stock Exchange, Pacific Stock Exchange, Philadelphia Stock Exchange, Cincinnati Exchange, Boston Stock Exchange, Third Market Exchange, Instinet Exchange, Consolidated File Exchange and the Chicago Board of Options Exchange Equities Stream.

DEPR:

Each of these ticker stream input feeds consists of a stream of input messages each conforming to a specific predetermined input message protocol. As used herein, an input message consists of a packet of financial market data organized according to an input message protocol. For example, a single input message may include a ticker symbol identifying a particular security, a bid price, an ask price, a trade price, a trade volume, a timestamp and other header and error correction data. Input feed subsystem 50 accumulates each such input message and passes the complete input message to the message conversion subsystem 52.

DEPR:

DQA subsystem 64 provides an interface for manual processing of corrections, errors, exceptions and administrative messages that cannot be automatically processed. DQA subsystem 64 also provides an interface for manual maintenance of market data file 58. Although data records for new securities can be added to market data file 58 as updates for new ticker symbols are received, this process is manually monitored through DQA subsystem 64, which also provides for the manual addition, deletion and adjustment to data content needed to accommodate financial market circumstances such as stock splits and dividend payments that are unreported in the input ticker streams.

DEPR:

Custom feeds management subsystem 78 receives requests from the underlying network by way of interface 72 to LAN 28 for the addition or deletion of security ticker symbols to one of several feed lists in a custom feed definition file. All such requests are first referred to CSS 48 (FIG. 1) for verification before modifying custom feed content. Custom feeds subsystem 78 permits dynamic reconfiguration of a plurality of custom feeds tailored to individual customer requirements.

DEPR:

Each logical instance of message validation subsystem 56 reads market data file 58 searching for the existence of the security named in an incoming internal message. Particular security is not found, subsystem 56 adds the security to data file 58 using a predefined parameter set for new data records. Additionally, the subsystem 56 instance generates a message to knockout file 65 indicating that the particular security was not found and providing information necessary to locate the newly created record keyed to the "ticker symbol" for that security. This procedure permits manual override of the automated procedure by a data quality administrator should the "new" security symbol arise because of error at the source of the incoming message. Because some financial data sources transmit messages conveying symbol additions, deletions and changes, message validation subsystem 56 automatically updates market data file 58 to reflect these changes. These automatic ticker symbol additions, deletions and changes also generate messages to knockout file 65 to permit the manual entry of any additional information required.

DEPR:

Message validation subsystem 56 also performs the derivative data calculations stored in market data file 58. Additional to the current derivative data such as "day high", "day low" and "net change from previous close", CTP 22 maintains an update sequence number for each ticker symbol in addition to independent trading session derivative data, true 52-week highs and lows, contract life high/low, and a tally of new highs/lows for the day. A separate consolidated record is updated to provide these derivative data for issues that trade in a consolidated market over many different exchanges, such as many of the equities listed in the primary U.S. markets.

DEPR:

Subsystem 56 updates market data file 58 and history file 60 and adds broadcast feed information, which includes a bit map of the message destinations for the particular security data within each transaction message. The broadcast feed information is stored with each ticker symbol in market data file 58. The transaction message enhanced by a broadcast feed bitmap is then retrieved from market data file 58 by subsystem 56 and transmitted to broadcast feeds subsystem 62 over interface 88. The appropriate statistics are then updated in market data file 58, which maintains a current record for each ticker security symbol. History file 60 maintains a history of updates applied to the current security record throughout the trading day for every security ticker symbol, which information is maintained primarily for error correction processing.

DEPR:

A periodic refresh cycle generation logic within each instance of message validation subsystem 56 automatically generates refresh messages that are transmitted on the broadcast feed at a priority lower than the primary data update messages. The refresh cycle provides a second level of assurance that all message destinations have the same data as the CTP. The refresh cycle is the only source for correcting customer systems that elect not to use the retransmission recovery service discussed below. Messages in the refresh cycle contain all "dynamic" data fields maintained for each security type. Logic provides for "intelligent" refresh that permits tracking of specific issues that experience recent activity in the market. The intelligent refresh option is normally active during the active issuend, when active, only the active issues are transmitted during the refresh cycle. The refresh cycle processing logic also transmits updates needed to prepare the remote system (CTP 45 in FIG. 1) files for the next market open of exchanges where trading is not continuous around the clock. Messages in the market-open cycle contain both dynamic (updated by market activity) and static (not updated by market activity) data fields. The transmitted static data fields include any defined system-wide "alias" symbols for the security issue.

DEPR:

Message validation subsystem 56 receives requests from custom feeds management subsystem 78 (FIG. 2) for the addition or deletion of ticker symbols from specified custom feed lists. These requests are validated before transmission from custom feeds management subsystem 78 for both entitlement to modify the feed and entitlement for the data. Subsystem 78 also verifies that the requested data will not cause the custom feed to exceed its allocated bandwidth. Message validation subsystem 56 updates the Market Data File 58 record for each security affected by the custom feed request and adds/deletes the feed from the list of feeds to which the symbol is a member. Whenever a symbol is added to a feed, message validation subsystem 56 generates a summary message for that symbol and marks it for transmission on the feed to which it has been added.

DEPR:

Messages are passed from validation subsystem 56 to DQA subsystem 64 (FIG. 2) in CTP internal protocol by way of kickout file 65 over the interface 90. Interface 90 handles several types of messages, including exchange-generated correction messages, exchange-generated administrative messages, exception messages and invalid messages that failed header/field validation tests within subsystems 52 and/or 56. Each of these messages has the logical contents necessary to support the subsequent processing logic. For example, an exchange-generated correction message can include a correction header, correction source, message type (cancellation, error or correction), timestamp, original security data (exchange ID, symbol ID, symbol sequence number, volume size, last price), and corrected security data (exchange ID, symbol ID, volume size, last price). The resulting transaction message created by an instance of subsystem 56 and transmitted over interface 90 is herein denominated an adjustment message. Adjustment messages are created following the update of market data file 58 and history file 60 and are sent by subsystem 56 over interface 88 to broadcast feeds subsystem 62 for distribution to the underlying network destinations. An exemplary adjustment message includes the adjustment type (volume adjustment or volume and low price or volume and high price or price adjustment), security data (exchange ID, symbol ID, symbol sequence number), and trade data (volume size, last price). Adjustment messages that cannot be processed by message validation subsystem 56 are forwarded to kickout file 65 for manual processing in DQA subsystem 64 (FIG. 2).

DEPR:

Administrative messages are received from input feed subsystem 50 and processed by message conversion subsystem 52. An exemplary administrative message includes administrative header, administrative source, network ID, CTP ID, message type, timestamp, exchange ID, and administrative text. Responses to such administrative messages create updates to market data file 58 and, in some cases, history file 60. Such updates may include an adjustment or transmission of a response to broadcast feeds subsystem 62. An exemplary response to an administrative message includes message type, security data, exchange ID, symbol ID, symbol sequence number, optional flags, administrative data, creation date, termination date, and action (new security/issue, termination of security/issue, earnings data modifications, trade history update, X-dividend, stock split, etc.) Administrative messages that cannot be processed by message validation subsystem 56 are forwarded to kickout file 65 for manual processing in DQA subsystem 64.

DEPR:

Exception messages are those messages that are rejected by message validation subsystem 56. Exception messages require manual intervention by a data quality administrator who must analyze the exception message and enter the corrected data. An exemplary exception message includes exception header, exception source (network ID, CTP ID), message type (no find, price kickout, volume kickout or text message), timestamp, exception code, security data (exchange ID, symbol ID, symbol sequence number) and trade data (volume size, last price). Each exception message demands a manual response, which may result in message rejection or correction by updates transmitted to market data file 58. A manual adjustment or other response to each exception message is transmitted by message validation subsystem 56 to broadcast feeds subsystem 62 and therefrom to the underlying destination network.

DEPR:

Market statistic subsystem 66 also receives, processes and responds to requests for the addition, deletion, listing and correction of statistics forwarded from

DQA subsystem 64. A plurality of logical applications within market statistics subsystem 66 includes statistics logic for creating market-related statistics such as volumes, averages, trends and the like, options volatility indices (OVIs) as used by Dynamic Options Class Display (DOCD) systems, and the creation, maintenance and distribution of security instrument lists of related symbols such as option class lists for all option series traded.

DEPR:

Broadcast feeds history file 70 contains a series of records each containing the block number, symbol ID and a pointer to the transaction log file 68 location for each transaction message in the block. Broadcast feeds history file 70 data are used to reconstruct a block for retransmission to any of the feed message destinations. The history file 70 record is completed and saved when a transmission block is filled and sent or when no more data are available for transmission and the block is closed and sent partially full. Partially-filled transmission blocks are sent when sufficient transaction data are not available to keep the transmission current (e.g., within 500 ms of transaction timestamp).

DEPR:

FIG. 4 shows the feed management data flow diagram for CTP 22 (FIG. 1). Custom feeds management subsystem 78 accepts feeds manipulation requests from DQA subsystem 64 on an interface 96. Subsystem 78 also accepts feed manipulation requests from users in the underlying destination network on interface 72. Subsystem 78 validates user entitlement by requesting it from CSS system 48 (FIG. 1). If the user is entitled to manipulate the feed definition and the feed is not at its bandwidth capacity limit, subsystem 78 forwards the request as an internal message to the appropriate instance of message validation subsystem 56 on an interface 98. Message validation subsystem 56 adds or removes the feed indicator for the symbols in the request, generates a refresh-summary transaction message for adding the symbol to the feed request and forwards the message to broadcast feeds subsystem 62 for distribution to the requested feed only. Message validation subsystem 56 responds to custom feeds management subsystem 78, which responds to the requester specifying a completion code.

DEPR:

The custom feeds are limited in number to the system hardware capacity provided for CTP 22. A custom feed change request includes the feed identifier, the action to be taken (add, delete or display) and the ticker symbol or list of symbols (including wild-card designations). Because each record (symbol) in market data file 58 includes a list of feeds (message destinations) to which it is a member, custom feeds management subsystem 78 manipulates market data file 58 records by way of message validation of system 56. If a change cannot be permitted, a message is sent to the requesting system denying the request and a rejection is produced and transmitted to kickout file 65 for monitoring and follow-up by the DQA operator. The requested change takes effect before the next update is received by message validation subsystem 56 for the relevant symbol. The feed list change also causes subsystem 56 to generate a summary message for broadcast by subsystem 62 to the underlying network. A response to the request is also sent to the requesting customer system by the same route.

DEPR:

Custom feeds management subsystem 78 processes requests as described above without logic for mediating conflicting requests. Where more than one terminal is entitled to send custom feed update requests for a single custom feed, no attempt is made to keep the symbol in the feed until all terminals have requested that it be removed, for instance.

DEPR:

FIG. 5 provides a schematic view of the DQA data flow of the CTP 22 from FIG. 1. DQA subsystem 64 receives copies of the messages from kickout file 65 that have failed testing by message conversion subsystem 52 or message validation subsystem 56. DQA subsystem 64 may request the entire current record for the symbol requiring correction by way of message validation subsystem 56 and then may perform correction and forward the corrected record to subsystem 56 for storage in market data file 58 and history file 60. All manual operator activity is logged to a corrections log file 100. Subsystem 64 also requests that market statistics subsystem 66 add/delete or modify statistics or may request that custom feeds management subsystem 78 add or delete symbols and so forth. This corrections function includes making online adjustments to the market data

responsive to data received in correction messages from the exchanges (when these cannot be automatically processed), exception messages from message validation subsystem 56, administrative messages from the exchanges and data from a number of other sources such as reports and newspapers.

DEPR:

DQA subsystem 64 provides an audit log of all manual activity and maintains statistics to monitor performance at the group and individual level. Daily performance and market activity reports are created automatically. A manual interface is provided to permit setting of the message validation parameters and changing of the mode to enable or disable the validation testing by security type within each exchange. DQA subsystem 64 also provides an interface to the Exchange Definition Table to permit trading schedule modification for any of the exchanges that source financial data to the CTP system. The Exchange Definition Table is used to schedule the maintenance processes that are periodically performed on the CTP system files. Subsystem 64 also provides manual interface for the custom feeds administration function that supports the display, addition and deletion of symbols from individual custom feeds. Finally, DQA subsystem 64 provides a manual interface to market statistics management subsystem 66 that permits definition, monitoring and adjustment of the internally-calculated market statistics.

DEPR:

DQA subsystem 64 communicates with custom feeds management subsystem 78 on interface 96. Subsystem 78 processes DQA requests and responds to DQA subsystem 64 after feed manipulation is complete. Messages are sent and received in sequential order and interface 96 does not support priority queuing or any method of message manipulation. Messages between subsystems 64 and 78 include add/delete symbol to/from a feed, add/delete feed, and modify symbol/feed parameters.

DEPR:

DQA subsystem 64 communicates with market statistics calculation subsystem 66 by way of interface 102. Subsystem 64 forwards statistics manipulation messages to subsystem 66 which processes and responds following completion of the requested statistics manipulation. Message are sent and received in sequential order and interface 102 does not support priority queuing or any method of message manipulation. Interface 102 handles messages including add/delete market statistics, add/delete symbol to/from statistics, modify market statistics parameters and modify statistics value.

DEPR:

Custom feeds management subsystem 78 communicates with message validation subsystem 56 through interface 88. Subsystem 78 forwards feeds manipulation messages to message validation subsystem 56, which processes the requests and responds following completion of the feed manipulation. Messages sent on interface 88 are received in sequential order and interface 88 does not support priority queuing nor any method of message manipulation. The types of messages sent between subsystems 56 and 78 include add/delete symbol to/from a feed and response to add/delete symbol request.

DEPR:

The retransmission request identifies the specific feed, the range of missed output data blocks and type of recovery desired, whether tick-by-tick or current data. For tick-by-tick recovery, subsystem 74 uses data from broadcast feeds history file 70 and transaction log file 68 to reconstruct the original blocks of transaction messages and sends the blocks in sequence over interface 76 with a flag to indicate "tick-by-tick" recovery. For current data recovery, subsystem 74 uses broadcast feeds history file 70 and knowledge of the missing block range to obtain a list of symbols that were updated during the missed sequence. This "missed" symbol list is then used to obtain data for each symbol from market data file 58 and recreate current market data record summary messages for each "missed" symbol. These summary messages are transmitted on the virtual recovery circuit (interface 76) with a flag to indicate "current data" recovery. Current data recovery transmission blocks contain new block sequence numbers assigned at the time of the recovery session and have no relation to the original update transmission blocks or sequence numbers.

DEPV:

(c) correction processing: compare original trade data to correction data and, accordingly adjust volume, price or both. For symbol correction processing,

adjust volume and price per symbol.

CCOR:
705/35

CCXR:
705/37

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L13: Entry 6 of 9

File: USPT

Nov 16, 1999

US-PAT-NO: 5987432

DOCUMENT-IDENTIFIER: US 5987432 A

TITLE: Fault-tolerant central ticker plant system for distributing financial market data

DATE-ISSUED: November 16, 1999

INVENTOR-INFORMATION:

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APPL-NO: 8/ 998983

DATE FILED: December 29, 1997

PARENT-CASE:

This application is a continuation of Ser. No. 08/269,232, now abandoned, filed Jun. 6, 1994.

INT-CL: [6] G06F 17/60

US-CL-ISSUED: 705/35; 705/37, 709/260

US-CL-CURRENT: 705/35; 705/37, 714/11

FIELD-OF-SEARCH: 705/35, 705/36, 705/37, 705/1, 707/10, 707/104, 380/49, 395/500.44, 395/500.48, 709/247, 709/260, 370/242, 370/216

PRIOR-ART-DISCLOSED:

U.S. PATENT DOCUMENTS

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PAT-NO	ISSUE-DATE	PATENTEE-NAME	US-CL
<input type="checkbox"/> <u>3082402</u>	March 1963	Scantlin	N/A
<input type="checkbox"/> <u>3513442</u>	May 1970	Sieracki	N/A
<input type="checkbox"/> <u>3611294</u>	October 1971	O'Neill et al	N/A
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<input type="checkbox"/> <u>4554418</u>	November 1985	Toy	N/A
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<input type="checkbox"/> <u>4665519</u>	May 1987	Kirchner et al.	N/A
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<input type="checkbox"/> <u>4677434</u>	June 1987	Fascenda	N/A
<input type="checkbox"/> <u>4677552</u>	June 1987	Sibley, Jr.	N/A
<input type="checkbox"/> <u>4868866</u>	September 1989	Williams, Jr.	N/A
<input type="checkbox"/> <u>4942616</u>	July 1990	Linstroth et al.	N/A
<input type="checkbox"/> <u>4989141</u>	January 1991	Lyons et al.	N/A
<input type="checkbox"/> <u>5038284</u>	August 1991	Kramer	N/A
<input type="checkbox"/> <u>5045848</u>	September 1991	Fascenda	N/A
<input type="checkbox"/> <u>5101353</u>	March 1992	Lupien et al.	N/A
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<input type="checkbox"/> <u>5131020</u>	July 1992	Liebesny et al.	N/A
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<input type="checkbox"/> <u>5557780</u>	September 1996	Edwards et al.	N/A
<input type="checkbox"/> <u>5710889</u>	January 1998	Clark et al.	N/A
<input type="checkbox"/> <u>5774878</u>	June 1998	Marshall	N/A
<input type="checkbox"/> <u>5864827</u>	January 1999	Wilson	N/A
<input type="checkbox"/> <u>5870719</u>	February 1999	Martizen et al.	N/A
<input type="checkbox"/> <u>5893079</u>	April 1999	Cwenar	N/A

ART-UNIT: 274

PRIMARY-EXAMINER: Weinhardt; Robert A.

ATTY-AGENT-FIRM: Baker & Maxham

ABSTRACT:

A central ticker plant system for distributing financial market data that receives ticker feed data from many exchanges throughout the world, processes and formats the received data and then distributes or broadcasts the data to regional customers in the form of securities transactional data denoting the security identity and related transactional data. The central ticker plant system is fault-tolerant because of novel hardware redundancy and multi-thread software processing architecture and operates continuously during hardware and software maintenance and repair, ensuring that every financial market data message received from the exchanges is included within 500 milliseconds in broadcast output.

18 Claims, 12 Drawing figures